WHAT IS CLAIMED IS:

- A heterodiamondoid comprising a diamondoid nucleus selected from a triamantane or higher diamondoid nucleus having at least one of its carbon atoms replaced by a heteroatom.
- 2. The heterodiamondoid of claim 1 wherein at least one secondary carbon in the diamondoid nucleus is replaced by a heteroatom.
- 3. The heterodiamondoid of claim 1 wherein at least one tertiary carbon in the diamondoid nucleus is replaced by a heteroatom.
- 4. The heterodiamondoid of claim 1 comprising one heteroatom.
- 5. The heterodiamondoid of claim 1 comprising more than one heteroatoms.
- 6. The heterodiamondoid of claim 1 comprising two or more different heteroatoms.
- 7. The heterodiamondoid of claim 1 wherein the at least one heteroatoms are independently selected from the IIIB, non-C IVB, VB and VIB atoms in the periodic table of the elements.
- 8. The heterodiamondoid of claim 7 wherein the at least one heteroatoms are independently selected from the group consisting of the following atoms: Se, As, B, Al, Si, N, P, O and S.
- 9. A heterodiamondoid of claim 1 wherein the diamondoid nucleus is a triamantane nucleus.
- 10. A heterodiamondoid of claim 1 wherein the diamondoid nucleus is a higher diamondoid nucleus.

- 11. A heterodiamondoid of claim 1 wherein at least one of the heteroatoms replacing a carbon atom is an electron-donating heteroatom.
- 12. The heterodiamondoid of claim 11, wherein the electron-donating heteroatom is a group VB element.
- 13. The heterodiamondoid of claim 11, wherein the electron-donating heteroatom is selected from the group consisting of nitrogen, phosphorus, and arsenic.
- 14. The heterodiamondoid of claim 11, which is an aza-diamondoid.
- 15. The heterodiamondoid of claim 11, wherein the electron-donating heteroatom is sp³-hybridized in the diamond lattice.
- 16. A heterodiamondoid of claim 1 wherein at least one of the heteroatoms replacing a carbon atom is an electron-withdrawing heteroatom.
- 17. The heterodiamondoid of claim 16, wherein the electron-withdrawing heteroatom is a group IIIB element.
- 18. The heterodiamondoid of claim 17, wherein the electron-withdrawing heteroatom is selected from the group consisting of boron and aluminum.
- 19. The heterodiamondoid of claim 18, wherein the electron-withdrawing element is boron.
- 20. The heterodiamondoid of claim 16, wherein the electron-withdrawing heteroatom occupies a substitutional site on the diamond lattice.
- 21. The heterodiamondoid of claim 16, wherein the electron-withdrawing heteroatom is sp³-hybridized in the diamond lattice.
- 22. A method of synthesizing an aza-diamondoid, the method comprising:

- a) converting a diamondoid selected from triamantane and the higher diamondoids to a hydroxy-diamondoid;
- b) preparing an aza-homodiamondoid-ene from the hydroxydiamondoid;
- c) preparing an epoxy aza-homodiamondoid from the azahomodiamondoid-ene; and
- d) preparing an aza-diamondoid from the epoxy azahomodiamondoid.
- 23. A method of synthesizing an aza-diamondoid, the method comprising:
 - a) oxidizing a diamondoid selected from triamantane and the higher diamondoids to a keto-diamondoid;
 - b) preparing a fragmented diamondoid-ene carboxylic acid from the keto-diamondoid;
 - c) preparing a fragmented diamondoid-ene acetate from the fragmented diamondoid-ene carboxylic acid;
 - d) preparing a fragmented hydroxy-diamondoid-ene by reducing the fragmented diamondoid-ene acetate;
 - e) preparing a fragmented keto-diamondoid-ene by oxidizing the fragmented hydroxy-diamondoid-ene;
 - f) preparing a fragmented diamondoid=N-OH-ene from the fragmented keto-diamondoid-ene;
 - g) preparing an aza-diamondoid from the fragmented diamondoid=N-OH-ene.
- 24. A method of preparing heterodiamondoid, the method comprising:
 - a) isolating a diamondoid selected from triamantane and the higher diamondoids from a petroleum feedstock;

- converting the diamondoid into a heterodiamondoid by substitutionally positioning an electron-donating heteroatom on a diamond crystal lattice position.
- 25. A method of preparing heterodiamondoid, the method comprising:
 - a) isolating a diamondoid selected from triamantane and the higher diamondoids from a petroleum feedstock;
 - b) converting the diamondoid into a heterodiamondoid by substitutionally positioning an electron-withdrawing heteroatom on a diamond crystal lattice position.
- 26. A functionalized heterodiamondoid comprising a heterodiamondoid of claim 1 with one or more covalently-bonded functional groups pendant from its diamondoid nucleus.
- 27. A functionalized heterodiamondoid comprising a heterodiamondoid of claim 8 with one or more covalently-bonded functional groups pendant from its diamondoid nucleus.
- 28. A functionalized heterodiamondoid comprising a heterodiamondoid of claim 10 with one or more covalently-bonded functional groups pendant from its diamondoid nucleus.
- 29. The functionalized heterodiamondoid of claim 26 wherein the one or more functional groups comprise a group selected from the group consisting of halo, thio, oxide, hydroxyl, nitro, sulfonylhalide, sulfonate, phosphine, added alkyl, alkenyl, alkynyl and aryl, with or without substitution.
- 30. A functionalized heterodiamondoid of claim 26 wherein the one or more functional groups comprise a halo.

- 31. The functionalized heterodiamondoid of claim 26 wherein the one or more functional groups comprise a hydroxide.
- 32. The functionalized heterodiamondoid of claim 26 wherein the one or more functional groups comprise an oxide.
- 33. The functionalized heterodiamondoid of claim 26 wherein the one or more functional groups comprise a nitrate.
- 34. The functionalized heterodiamondoid of claim 26 wherein the one or more functional groups comprise a group selected from the group consisting of haloalkyl; haloalkenyl; haloalkynyl; hydroxyalkyl; heteroaryl; alkylthio; alkoxy; aminoalkyl; aminoalkoxy; heterocycloalkoxy; cycloalkyloxy; aryloxy; heteroaryloxy; -C(O)Z wherein Z is hydrogen, alkyl, halo, haloalkyl, halothio, amino, monosubstituted amino, disubstituted amino, cycloalkyl, aryl, heteroaryl; -CO₂Z; -R⁷COZ wherein R⁷ is alkenyl, aminoalkenyl, or haloalkenyl; -R⁷COOZ; -OSO₃H; NH₂; NHR'; NR'R"; and N⁺R'R"R" wherein R', R", and R" are independently alkyl, thio, thioalkyl, heteroalkyl, aryl, or heteroarvl: R⁸NHCOR⁹ wherein R⁸ is selected from the group consisting of CH₂, OCH₂, NHCH₂, CH₂CH₂, and OCH₂CH₂ and R⁹ is selected from the group consisting of alkyl, aryl, heteroaryl, aralkyl, and heteroaraylkly; and R¹⁰CONHR¹¹ wherein R¹⁰ is selected from the group consisting of CH₂, OCH₂, NHCH₂, CH₂CH₂, and OCH₂CH₂, and R¹¹ is selected from the group consisting of alkyl, aryl, heteroaryl, aralkyl, and heteroaralkyl.
- 35. The functionalized heterodiamondoid of claim 26, wherein the one or more functional groups comprise a polymerizable functional group.
- 36. The heterodiamondoid of claim 1 as a discrete molecule.
- 37. The heterodiamondoid of claim 1 as a crystal.